AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Previously presented) A calibration apparatus for array antenna transmission links, where each transmission link comprises an array transmitter, n power amplifiers, n uplink and downlink signal separating apparatuses, and n antenna units, the array transmitter, the n power amplifiers and the n uplink and downlink signal separating apparatuses are placed in a base station, an output of a base band signal processing module is inputted into the array transmitter, n channels of signal are transmitted by the array transmitter, after going through the power amplifiers and uplink and downlink signal separating apparatuses, the n channels of signal are transmitted through the antenna units, the calibration apparatus comprising:

a power detecting signal separating apparatus,

a power detecting signal feeder apparatus,

a power detecting apparatus,

a signal synthesizing apparatus, and

an array calibration apparatus;

wherein

the power detecting signal separating apparatus receives an RF signal from the uplink and downlink signal separating apparatuses, filters out a DC signal from the RF signal, and transmits a filtered RF signal of high frequency to the power detecting signal feeder apparatus;

the power detecting signal feeder apparatus is configured to transmit the high frequency RF signal outputted by the power detecting signal separating apparatus;

the signal synthesizing apparatus coupled with the n antenna units is configured to synthesize the filtered high frequency RF signal from the power detecting signal feeder apparatus and output the synthesized RF signal to the power detecting apparatus;

the power detecting apparatus is configured to detect a power of a synthesized RF signal coming from the signal synthesizing apparatus, and output a feedback power signal to the power detecting signal feeder apparatus;

the power detecting signal feeder apparatus is further configured to mix the feedback power signal outputted by the power detecting apparatus and the filtered high frequency RF signal, and transmit a mixed signal to the power detecting signal separating apparatus;

the power detecting signal separating apparatus is further configured to recover the feedback power signal from the mixed signal from the power detecting signal feeder apparatus, adjust a calibration weight, and transmit an adjusted calibration weight to the array calibration apparatus;

the array calibration apparatus placed between the base band signal processing module and the array transmitter is configured to calibrate the array antenna transmission links according to the adjusted calibration weight.

2. (Previously presented) The calibration apparatus of array antenna transmission links according to claim 1, wherein the signal synthesizing apparatus, the signal power detecting apparatus, and the power detecting signal feeder apparatus can form an outdoor unit with the n antenna units, the outdoor unit is connected with the base station via RF cables.

3. (Previously presented) The calibration apparatus of array antenna transmission links according to claim 1, wherein the signal synthesizing apparatus includes a Bulter matrix, (n-1) couplers, (n-1) filters and (n-1) adjustable attenuators, wherein the couplers, the filters and the adjustable attenuators are provided in first (n-1) transmission links the coupler is configured to separate a small part of the RF signal from an RF beam signal formed according to the Bulter matrix; the separated RF signal is filtered by the filters and attenuated by the adjustable attenuators, then sent to the signal power detecting apparatus.

4. (Previously presented) The calibration apparatus of array antenna transmission links according to claim 3, wherein an attenuation of a source RF signal caused by the separated RF signal does not exceed 1 dB.

5. (Previously presented) The calibration apparatus of array antenna transmission links according to claim 3, wherein the signal power detecting apparatus is comprised of (n-1) detectors and (n-1) amplifiers, corresponding to the first (n-1) transmission links; an RF signal of

the first (n-1) transmission links form a feedback power signal after processed by the detectors and the amplifiers, the feedback power signal is outputted to the power detecting signal feeder apparatus.

6. (Previously presented) The calibration apparatus of array antenna transmission links according to claim 3, wherein the power detecting signal feeder apparatus includes n signal feeder units, corresponding to n transmission links, respectively, each of the signal feeder units includes: an inductive circuit L, a capacity circuit C1 and a capacity circuit C2;

when for signal feeder units of a first transmission link to an $(n-1)^{th}$ transmission link, wherein the inductive circuit L is configured to mix a low frequency signal of a feedback power signal with a high frequency RF signal, the capacity circuit C2 is configured to filter a high frequency part of the feedback power signal, the capacity circuit C1 is configured to prevent sending the low frequency signal of a power detecting signal to the antenna units; and

when the inductive circuit L in an n^{th} transmission link is configured to separate a power supply signal from a high frequency RF signal, the capacity circuit C2 is configured to filter a high frequency part of the power supply signal, the capacity circuit C1 is configured to prevent sending the power supply signal to the antenna units.

7. (Previously presented) The calibration apparatus of array antenna transmission links according to claim 3, wherein the power detecting signal separating apparatus includes n inductive circuits L, n capacity circuits C3, n capacity circuits C4, (n-1) A/D converters and a calibration weight calculating apparatus, wherein an n^{th} transmission link does not have an A/D converter;

when for each of a first to an $(n-1)^{th}$ transmission links, an inductive circuit L is configured to separate a feedback power signal from a mixed signal; the capacity circuit C4 is configured to filter a high frequency part of the feedback power signal; a capacity circuit C3 is configured to prevent sending the feedback power signal to the uplink and downlink signal separating apparatus of a corresponding transmission link;

when for an n^{th} transmission link, an inductive circuit L is configured to mix a power supply signal with a high frequency RF signal; a capacity circuit C4 is configured to filter a high

frequency part of the power supply signal; a capacity circuit C3 is configured to prevent sending the power supply signal to an n^{th} uplink and downlink signal separating apparatus;

the A/D converter is configured to perform A/D converting for a low frequency feedback power signal, and transmit a converted signal to the calibration weight calculating apparatus; and

the calibration weight calculating apparatus is configured to adjust a calibration weight according to a value of a received feedback power signal.

8. (Previously presented) The calibration apparatus of array antenna transmission links according to claim 1, wherein the signal synthesizing apparatus is comprised of n couplers, n filters and one signal synthesizer with n channels; the coupler is configured to separate a small part of an RF signal from a high frequency RF signal outputted by the power detecting signal feeder apparatus; the separated RF signal is sent to the synthesizer after processed by the filters, then a synthesized RF signal is outputted to the power detecting apparatus.

9. (Currently amended) The calibration apparatus of array antenna transmission links according to claim 8, wherein the power detecting apparatus is comprised of a detector and [[a]] an amplifier; a synthesized RF signal forms a feedback power signal through processing of the detector and the amplifier, and is sent to the power detecting signal feeder apparatus.

10. (Previously presented) The calibration apparatus of array antenna transmission links according to claim 8, wherein the power detecting signal feeder apparatus includes an inductive circuit L, a capacity circuit C1 and a capacity circuit C2 in any one of first (n-1) transmission links and an n^{th} transmission link; wherein

the inductive circuit L in any one of the first (n-1) transmission links is configured to mix a low frequency signal of a feedback power signal with a high frequency RF signal, the mixed signal is transmitted to a power detecting signal separating apparatus in the base station; the apparatus capacity circuit C2 is configured to filter a high frequency part of the feedback power signal; the capacity circuit C1 is configured to prevent sending the low frequency signal in the feedback power signal to the antenna units; and

the inductive circuit L of the n^{th} transmission link is configured to separate a power supply signal from a high frequency RF signal; the capacity circuit C2 is configured to filter a

high frequency part of the power supply signal; the capacity circuit C1 is configured to prevent sending the power supply signal to the antenna units.

11. (Previously presented) The calibration apparatus of array antenna transmission links according to claim 8, wherein the power detecting signal separating apparatus includes an inductive circuit L, a capacity circuit C3 and a capacity circuit C4 in any one transmission link which is chosen in a corresponding power detecting signal feeder apparatus and an n^{th} transmission link, the power detecting signal separating apparatus further includes an A/D converter and a calibration weight calculation apparatus; wherein

the inductive circuit L of the any one transmission link is configured to separate a feedback power signal from a mixed signal, the capacity circuit C4 is configured to filter a high frequency part of the feedback power signal, the capacity circuit C3 is configured to prevent sending the feedback power signal to a first uplink and downlink signal separating apparatus;

when the inductive circuit L of the n^{th} transmission link is configured to mix a power supply signal with a high frequency RF signal; the capacity circuit C4 is configured to filter a high frequency part of the power supply signal; the capacity circuit C3 is configured to prevent sending the power supply signal to an n^{th} uplink and downlink signal separating apparatus;

the A/D converter is configured to perform A/D converting for a low frequency feedback power signal, and transmit the converted low frequency feedback power signal to the calibration weight calculating apparatus; and

the calibration weight calculating apparatus is configured to adjust calibration weight according to a value of a received feedback power signal.

12. (Currently amended) A calibration method of array antenna transmission links comprising:

first, obtaining initial values of gain calibration weight and phase calibration weight of a transmission link;

then calculating the gain calibration weight and the phase calibration weight of the transmission link; and

calibrating a gain and a phase of an array transmission link using a calculated calibration weight,

wherein obtaining initial values of phase calibration weight of a transmission link further comprises: firstly, controlling at a base band each transmission link to send signal with a same phase;

then selecting a first transmission link as a reference channel, other channels as channels to be calibrated;

adjusting a phase of a transmission signal on the channels to be calibrated such that a signal power of a first antenna unit is at maximum and signal powers of other antenna units are at minimum;

saving a phase adjusting coefficient of transmission link at this time, which is represented by a vector $\begin{bmatrix} 0 & \phi_{adj1} & \cdots & \phi_{adjn} \end{bmatrix}$;

then calculating an inverse matrix W_{but}^{H} or W_{but}^{-1} of an equivalent transmission coefficient matrix of a Bulter matrix; and

choosing a first line vector of the inverse matrix, respected by $V_{bulter,1} = \begin{bmatrix} \phi_{1,1} & \phi_{1,2} & \cdots & \phi_{1,n} \end{bmatrix}$, wherein the initial value of the phase calibration weight for the transmission link is $\begin{bmatrix} \frac{0}{\phi_{1,1}} & \frac{\phi_{adj2}}{\phi_{1,2}} & \cdots & \frac{\phi_{adjn}}{\phi_{1,n}} \end{bmatrix}$.

13. (Currently amended) The calibration method of array antenna transmission links according to claim 12, wherein obtaining initial values of gain calibration weight and phase calibration weight of a transmission link further comprises:

controlling a base band signal to make a base station only having one channel of link transmission signal;

adjusting the [[the]] gain calibration weight for the transmission link such that a transmission power of the transmission link reaches a rated value, the gain calibration weight at this time is the initial value of the gain calibration weight for the transmission link; and

performing the above operation for all of transmission links in the base station, to get an initial value of gain calibration weight for each transmission link.

14. (Canceled)

15. (Currently amended) A [[The]] calibration method of array antenna transmission links ~~according to claim 12~~, comprising:

first, obtaining initial values of gain calibration weight and phase calibration weight of a transmission link;

then calculating the gain calibration weight and the phase calibration weight of the transmission link; and

calibrating a gain and a phase of an array transmission link using a calculated calibration weight,

wherein obtaining initial values of ~~gain calibration weight and~~ phase calibration weight of a transmission link further comprises:

firstly, choosing a transmission link as the reference channel, the other transmission links as the channel to be calibrated;

controlling the reference channel and one of the channels to be calibrated to transmit signal simultaneously;

adjusting a phase of a base band signal in the one channel to be calibrated to make a power of a synthesized signal of signals transmitted by the reference channel and the one channel to be calibrated at minimum, wherein a conjugate of a phase adjusting coefficient for the one channel to be calibrated is the initial value of the phase calibration weight for this channel; and

choosing another channel to be calibrated, repeating the depicted operation until obtaining initial values of phase calibration weight for each transmission link.

16. (Previously presented) The calibration method of array antenna transmission links according to claim 12, wherein calculating the gain calibration weight and the phase calibration weight of the transmission link further comprises:

taking a rated transmission power as a base power value for calibration;

then using a dichotomy method to calculate the gain calibration weight of the transmission link; and

adjusting the gain of the transmission link according to the calculated gain calibration weight, until the transmission power of the transmission link meets a requested transmission power.

17. (Currently amended) The calibration method of array antenna transmission links according to claim 16, wherein calculating the gain calibration weight and the phase calibration weight of the transmission link, further comprises:

step 1) setting a transmission link number NumCh =1;

step 2) judging whether the link number NumCh is larger than a number of transmission links of an array antenna, if the link number NumCh is larger than the number of the transmission links, then ending a gain calibration;

step 3) if the link number NumCh is less than or equal to the number of the transmission links, then controlling at a base band a transmission signal of a $NumCh^{th}$ transmission link;

step 4) detecting a power of a transmission signal to generate a feedback power signal;

step 5) performing an A/D converting for the feedback power signal, obtaining a power of the transmission signal;

step 6) judging whether an absolute value of a difference between the power obtained in step 5) and a rated power is less than a permitted error, if the difference is less than the permitted error, then adding 1 to the transmission link number NumCh, and jumping back to step 2);

step 7) if the absolute value of the difference is larger or equal to the permitted error, then judging whether the calibration can be continued, if the calibration can be continued, then using a dichotomy method to adjust the gain calibration weight of the transmission link, then calibrating the $NumCh^{th}$ transmission link according to an updated gain calibration weight, then jumping back to step 2); and

step 8) if the calibration cannot be continued, then prompting a failure of the gain calibration of the $NumCh^{th}$ transmission link, and ending the gain calibration of the transmission link,

wherein step 7) further comprises: judging whether an iterative number of the dichotomy method exceeds a predetermined number, if the iterative number exceeds the predetermined number, then assuming that the calibration cannot be continued; if the iterative number does not exceed the predetermined number, further judging whether the gain calibration weight is at maximum or whether iterative weight values for a contiguous twice dichotomy method are same, if the gain calibration weight is at maximum or the weight values for the contiguous twice dichotomy are the same, then assuming that the calibration cannot be continued.

18. (Canceled).

19. (Currently amended) The calibration method of array antenna transmission links according to claim 12 [[14]], wherein obtaining initial values of gain calibration weight and phase calibration weight of a transmission link further comprises:

choosing any line vector $V_{bulter,i} = \{\phi_{i,1} \quad \phi_{i,2} \quad \cdots \quad \phi_{i,n}\}$ from a conjugate matrix or an inverse matrix of the equivalent weight coefficient matrix of the transmission link of the Bulter matrix as a set of beam weights to weigh each channel of signal;

then using the Bulter matrix for RF beam forming; and

using a direct searching method to adjust the set of beam weights continuously, until a signal only has a signal is only outputted at an i^{th} antenna unit port after Bulter matrix beam forming, and no signal is outputted at other antenna unit ports, at that time a beam weight of the transmission link is marked as $\{w_1 \quad w_2 \quad \cdots \quad w_n\}$, then a final phase calibration weight of the transmission link is $W_{PHASE} = \left\{\frac{w_1}{\phi_{i,1}} \quad \frac{w_2}{\phi_{i,2}} \quad \cdots \quad \frac{w_n}{\phi_{i,n}}\right\}$.

20. (Previously presented) The calibration method of array antenna transmission links according to claim 19, wherein obtaining initial values of gain calibration weight and phase calibration weight of a transmission link further comprises:

step 1) setting a transmission link number NumCh =1, setting an initial value of a phase calibration weight Wphase(0)=[0, 0, …, 0], a maximum loop number is M, an initial value of a loop variation loop is 0;

step 2) controlling the transmission signal of the transmission link at the base band;

step 3) detecting a power of the transmission signal, form a feedback power signal;

step 4) performing an A/D conversion for the feedback power signal, and obtaining the power of the transmission signal, saving a power value;

step 5) adding 1 to a phase calibration weight of a $NumCh^{th}$ transmission link, judging whether the phase calibration weight of the $NumCh^{th}$ transmission link exceeds a value range of phase calibration weight; if the phase calibration weight of the $NumCh^{th}$ transmission link does

not exceed the value range, then calibrating the phase of the NumChth transmission link, and jumping back to step 3);

step 6) if the phase calibration weight of the NumChth transmission link exceeds the value range, then judging whether a variation range of the power of the transmission signal meets a request, if the variation range does not meet the request, then prompting a failure of a phase calibration of the NumChth transmission link;

step 7) if the variation range meets the request, then recording a phase calibration weight corresponding to a maximum value of the power of the transmission signal, adding 1 to the transmission link number NumCh, then judging whether the transmission link number NumCh exceeds a number of transmission links of an array antenna, if the transmission link number NumCh does not exceed the number of the transmission links of the array antenna, then jumping back to step 3);

step 8) if the transmission link number NumCh exceeds the number of the transmission links of the array antenna, then setting the transmission link number NumCh as 1, adding 1 to a loop variation, the phase calibration weight Wphase (loop)=[w(1), w(2), ..., w(n)] is a phase calibration weight corresponding to the maximum value of the power of the transmission signal;

step 9) judging whether a current phase calibration weight Wphase(loop) is same as a calibration weight Wphase(loop-1) of last time, if they are the same, then assuming that the phase calibration of the transmission link is successful, modifying the calculated phase calibration weight using a first line vector $V_{bulter,1}$ of the inverse matrix of the equivalent weight coefficient matrix of the transmission link of the Bulter matrix, that is, $W_{PHASE} = W_{PHASE}(loop)/V_{bulter,1}$, ending the phase calibration; and

step 10) if they are not the same, then judging whether the loop variation loop is larger than the maximum loop number M, if the loop variation loop is larger than the maximum loop number M, then prompting a of the phase calibration of the transmission link, ending the phase calibration, otherwise jumping back to step 3).

21. (Previously presented) The calibration method of array antenna transmission links according to claim 15, wherein obtaining initial values of gain calibration weight and phase calibration weight of a transmission link further comprises:

taking any one of transmission links of an array antenna as a benchmark; and then adjusting a phase of other transmission links using algorithm to make an intensity of the synthesized signal reach maximum, then a corresponding vector $W_{PHASE} = [1 \quad e^{j\beta_2} \quad \cdots \quad e^{j\beta_n}]^T = [1 \quad e^{j(\phi_1-\phi_2)} \quad \cdots \quad e^{j(\phi_1-\phi_n)}]^T$ is the phase calibration weight of the transmission link of an array antenna, wherein ϕ_n stands for a phase of an n[th] transmission link, T stands for transpose operation.

22. (Currently amended) The calibration method of array antenna transmission links according to claim 21, wherein obtaining initial values of gain calibration weight and phase calibration weight of a transmission link further comprises:

step 1) setting a transmission link number NumCh =2, setting an initial value of a phase calibration weight of each of all transmission links as 0, that is Wphase=[0, 0, ..., 0];

step 2) judging whether the transmission link number NumCh is less than or equal to a number of transmission links in the array, if the transmission link number NumChis larger than the number of the transmission links, then ending the phase calibration of the transmission link;

step 3) if the transmission link number NumCh is less than or equal to the number of the transmission links, then controlling a transmission signal of a first transmission link and a NumCh[th] transmission link at a base band;

step 4) detecting a power of the transmission signal to form a feedback power signal;

step 5) performing an A/D conversion for the feedback power signal, obtaining the power of the transmission signal, and storing a power value;

step 6) adding 1 to a phase calibration weight of the NumCh[th] transmission link, judging whether the phase calibration weight of the NumCh[th] transmission link is less than or equal to a value range of phase calibration weight, if the phase calibration weight of the NumCh[th] transmission link is less than or equal to the value range, then calibrating a phase of the NumCh[th] transmission link, then jumping back to step 2);

step 7) if the phase calibration weight of the NumCh transmission link is larger than the value range, then judging whether a variation range of the power of the transmission signal can meet a request, if the variation range cannot ~~can not~~ meet the request, then prompting a failure of the phase calibration of the NumCh[th] transmission link;

step 8) if the phase calibration weight of the NumCh transmission link meets the request, then recording the phase calibration weight corresponding to a maximum value of the power of the transmission signal, then adding 1 to the transmission link number, jumping back to step 2).

23. (New) The calibration method of array antenna transmission links according to claim 15, wherein obtaining initial values of gain calibration weight and phase calibration weight of a transmission link further comprises:

controlling a base band signal to make a base station only having one channel of link transmission signal;

adjusting the gain calibration weight for the transmission link such that a transmission power of the transmission link reaches a rated value, the gain calibration weight at this time is the initial value of the gain calibration weight for the transmission link; and

performing the above operation for all of transmission links in the base station, to get an initial value of gain calibration weight for each transmission link.

24. (New) The calibration method of array antenna transmission links according to claim 15, wherein calculating the gain calibration weight and the phase calibration weight of the transmission link further comprises:

taking a rated transmission power as a base power value for calibration;

then using a dichotomy method to calculate the gain calibration weight of the transmission link; and

adjusting the gain of the transmission link according to the calculated gain calibration weight, until the transmission power of the transmission link meets a requested transmission power.

25. (New) The calibration method of array antenna transmission links according to claim 24, wherein calculating the gain calibration weight and the phase calibration weight of the transmission link, further comprises:

step 1) setting a transmission link number NumCh =1;

step 2) judging whether the link number NumCh is larger than a number of transmission links of an array antenna, if the link number NumCh is larger than the number of the transmission links, then ending a gain calibration;

step 3) if the link number NumCh is less than or equal to the number of the transmission links, then controlling at a base band a transmission signal of a NumChth transmission link;

step 4) detecting a power of a transmission signal to generate a feedback power signal;

step 5) performing an A/D converting for the feedback power signal, obtaining a power of the transmission signal;

step 6) judging whether an absolute value of a difference between the power obtained in step 5) and a rated power is less than a permitted error, if the difference is less than the permitted error, then adding 1 to the transmission link number NumCh, and jumping back to step 2);

step 7) if the absolute value of the difference is larger or equal to the permitted error, then judging whether the calibration can be continued, if the calibration can be continued, then using a dichotomy method to adjust the gain calibration weight of the transmission link, then calibrating the NumChth transmission link according to an updated gain calibration weight, then jumping back to step 2); and

step 8) if the calibration cannot be continued, then prompting a failure of the gain calibration of the NumChth transmission link, and ending the gain calibration of the transmission link,

wherein step 7) further comprises: judging whether an iterative number of the dichotomy method exceeds a predetermined number, if the iterative number exceeds the predetermined number, then assuming that the calibration cannot be continued; if the iterative number does not exceed the predetermined number, further judging whether the gain calibration weight is at maximum or whether iterative weight values for a contiguous twice dichotomy method are same, if the gain calibration weight is at maximum or the weight values for the contiguous twice dichotomy are the same, then assuming that the calibration cannot be continued.